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Complete Specification

entitled ⁽⁵⁴⁾ IMPROVEMENTS IN OR RELATING TO FILTERS FOR
TOBACCO SMOKE

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9477/66

33.4; 21.5.

33.4; 33.5; 21.5; 28.3

21.5.

The following statement is a full description of this invention, including the best method of performing it known to us:

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F. D. Atkinson, Government Printer, Canberra

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This invention relates to filters for tobacco smoke and is more particularly, but not exclusively, concerned with the production of an improved filter construction which may be used either as a filter tip for a cigarette or as a filter in a cigarette holder.

It is known that the smoke derived from tobacco is very complex and includes a substantial solid content as well as gases. The solid content, which comprises tar, carbon and other matter including nicotine, is commonly referred to as "total particulate matters" (T.P.M.) and is considered to be the main source of substances which are injurious to the health of the smoker.

The gases in tobacco smoke include as the main constituents the usual products of combustion, carbon dioxide and water vapour, but they also include toxic gases, acetic acid, hydrogen sulphide and ammonium gases and sometimes hydrocyanic acid and carbon monoxide, all of which are considered as being harmful to the smoker. These harmful gases are present in varying proportions according to the kind or quality of tobacco and they impart an acid property to the tobacco smoke stream, because the ammonium gases, which are the only basic gases, are present in very small quantities. In fact the smoke from the tobacco which includes gases and the T.P.M. is characterised as being acidic.

Many attempts have been made to clean tobacco smoke without affecting the aroma or taste of the smoke. These previous proposals have included proposals for removing combustion gases by oxidation or other reaction and in particular attempts to remove the total particulate matters.

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These latter attempts have been based on the concept of a physical filtration of the tobacco smoke, but they have not been more than very partially successful.

The present invention is concerned with a filter which will prove very much more effective than the filters previously employed.

According to the present invention there is provided a filter for filtering tobacco smoke including at least a section consisting essentially of particles of calcium hydroxide having a particle size such that the particles will pass a 60 A.S.T.M. mesh sieve but be retained on an 80 A.S.T.M. mesh sieve, whereby, when tobacco smoke is drawn through the section, the tobacco smoke is subjected to both a chemical filtration and a physical filtration.

The double filtering action based on both a chemical filtration and a physical filtration arises in accordance with the present invention because the calcium hydroxide which is used in particulate form as the filter medium has an alkaline characteristic. The calcium hydroxide therefore reacts with the acid constituents of the smoke to remove these harmful constituents from the smoke, and, in doing so, to form water in the filter. This water which is formed on the particles of calcium hydroxide having a particle size in the range of 60 to 80 A.S.T.M. mesh sieve results in the filter in accordance with the present invention having effectively no air space within it, so that the smoke has to pass through the water, and a physical filtration through the water formed in the chemical reaction results. Thus the filtration is enhanced irrespective of whether conventional filter parts are present, in addition to the filter

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based on calcium hydroxide, or not.

Advantageously a filter in accordance with the present invention additionally includes conventional filter parts comprising separate sections of the filter between which is positioned the section consisting essentially of particles of calcium hydroxide.

Although other materials, for example magnesium hydroxide and strontium hydroxide, are similarly alkaline substances which will react with acid gases present in the smoke, it has been found that these other substances do not provide as efficient a combined chemical and physical filtration as do particles of calcium hydroxide.

It has also been found that the filter in accordance with the present invention is markedly more efficient than filters based on particles of calcium hydroxide having other particle sizes than the size which will pass through a 60 A.S.T.M. mesh sieve and be retained on an 80 A.S.T.M. mesh sieve.

Further in accordance with the present invention the substance for inclusion in the filter, that is to say the calcium hydroxide of the above stated range of particle size, is obtained by taking pure white marble, which is a pure crystalline compacted calcium carbonate and which is obtainable as such in nature, and heating it gradually over a period of four to five hours from room temperature to a temperature of $1,000^{\circ}\text{C}$, at which temperature the substance is maintained for one hour. Preferably the heating is carried out in an electric furnace. The resulting pure calcium oxide is cooled to normal temperature in a desiccator and is then mixed with a small amount of water sufficient to make a paste and is then dried at 140°C for about one hour.

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The material which is obtained after drying the paste is a specially treated form of slaked calcium hydroxide and this material, which is a white amorphous powder, is passed through fraction sieves to select those particles which lie within the range of particle size from 60 mesh sieve to 80 mesh sieve according to the A.S.T.M. Standard.

The quantity of the specially treated slaked calcium hydroxide which is included in the filter will depend on the smoke which is being filtered and therefore, in the case of tobacco smoke, on the tobacco which is being smoked. The operation of the filter will now be described, and it will be realised that it is contemplated that the chemical substance, preferably slaked calcium hydroxide of the stated range of particle size, may be included between conventional filter parts even though no mention of the conventional filter parts is made in the ensuing description.

When the filter in accordance with this invention is in use during smoking, for example, of a cigarette, the tobacco smoke which is drawn through the filter is carrying total particulate matters by reason of the velocity of the gas, which is dependent upon the suction effect induced by the smoker, and by reason of the overall density of the tobacco smoke, which enables the total particulate matters to be suspended in and carried by the tobacco smoke. When the passage of the smoke through the filter is impeded by the massed particles of slaked calcium hydroxide, the velocity of the tobacco smoke is reduced and a first deposition of total particulate matters occurs.

However, the tobacco smoke contains water vapour, and in the presence of this water vapour the calcium hydroxide particles of the filter react with the acid gases also present in the tobacco smoke. The reaction is the standard reaction

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of an acid and a base which yields the calcium salt of the acid and water.

The water which is formed in the chemical reaction accumulates in the filter as a liquid layer formed on the particles of calcium hydroxide themselves, and consequently the tobacco smoke which passes through the filter has to pass through this liquid layer. It is found that the tobacco smoke which has passed through the liquid layer of water is a mild, fresh and pleasant smoke which is inhaled by the smoker.

During the passage of the tobacco smoke through the water layer on the particles of calcium hydroxide comprising the filter, compounds, such as ammonia and nicotine, become partially dissolved in the water. The quantity of water present is comparatively small and therefore the quantity of the nicotine and ammonia dissolved is also small, but, as these compounds form a very small proportion of the total content of the tobacco smoke, there is an effective removal of these compounds by the dissolving in the water which is chemically produced in the filter.

It will therefore be understood that the acid gases, i.e. acetic acid, hydrogen sulphide, etc., are removed from the tobacco smoke by chemical reaction in the filter of this invention, and the ammonium gases are removed by being dissolved. These gases are some of the denser gases comprising the tobacco smoke, and when these gases have been removed the density of the tobacco smoke has been reduced by a substantial amount. The decrease in density of the tobacco smoke which takes place is a decrease from a density capable of carrying total particulate matters to a level of density which is not capable of carrying the total particulate matters. Consequently sedimentation takes place in the filter with the deposit of a very

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Large proportion of the total particulate matters.

In addition to the chemical reaction and the sedimentation consequent upon reductions in the velocity and density of the tobacco smoke, the action of drawing the tobacco smoke through the water layer formed in the filter has a physical filtration effect on the total particulate matters. There is a kind of surface cohesion effect which retains the total particulate matters in the water formed in the filter, that is to say on the particles of calcium hydroxide.

It is found that a filter including calcium hydroxide prepared as described above removes a very high percentage (in some cases as much as 90%) of the total particulate matters, the harmful gases and nicotine from the tobacco smoke without affecting the aroma and taste of the tobacco smoke. It is also found that tobacco smoke which has passed through a filter in accordance with this invention has had its acidity very substantially reduced, as confirmed by tests with the various indicators such as methyl red, methyl orange, etc., thus showing that acid constituents of the original smoke have been very largely removed.

Experiments have shown that, when the particle size of the calcium hydroxide particles used in a tobacco smoke filter of the kind described herein is greater than the range of particle size from 60 A.S.T.M. mesh sieve to 80 A.S.T.M. mesh sieve, the efficiency of the filter is substantially reduced. Also, if the particle size of the calcium hydroxide is decreased to include particles which will pass through an 80 A.S.T.M. mesh sieve, the filter tends to clog and is not nearly so satisfactory.

It will be understood that according to one aspect the

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present invention provides a method of filtering tobacco smoke by causing the main stream of gases comprising the tobacco smoke, which are acidic in nature and which contain water vapour, to come in contact with a mass of particles of calcium hydroxide, which is a non-toxic alkaline substance, the particles having a size such that they will pass through a 60 A.S.T.M. mesh sieve and be retained on an 80 A.S.T.M. mesh sieve, and to react therewith to produce neutral substances and water, which water forms a sheath on the granules and acts to dissolve other compounds present in the tobacco smoke, whereby the density of the gaseous components of the tobacco smoke is reduced sufficiently to cause total particulate matters in the tobacco smoke to be substantially deposited in the filter on the calcium hydroxide particles.

While it is preferred for a filter in accordance with the invention to be incorporated in a cigarette holder, it is equally within the ambit of the invention for the filter to be incorporated as part of a filter tip of a cigarette.

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The claims defining the invention are as follows:-

1. A filter for filtering tobacco smoke including at least a section consisting essentially of particles of calcium hydroxide having a particle size such that the particles will pass a 60 A.S.T.M. mesh sieve but be retained on an 80 A.S.T.M. mesh sieve, whereby, when tobacco smoke is drawn through the section, the tobacco smoke is subjected to both a chemical filtration and a physical filtration.
2. A filter according to Claim 1 which additionally includes conventional filter parts comprising separate sections of the filter between which is positioned the section consisting essentially of particles of calcium hydroxide.
3. A filter for filtering tobacco smoke comprising a mass of calcium hydroxide particles having a size such that the particles will pass a 60 A.S.T.M. mesh sieve but be retained on an 80 A.S.T.M. mesh sieve, manufactured and arranged to operate substantially as hereinbefore described.
4. A cigarette holder including a filter in accordance with any one of the preceding claims.
5. A cigarette including a filter tip having a filter in accordance with any one of Claims 1 to 3.
6. A method of preparing a filter for tobacco smoke comprising the steps of heating pure white marble gradually to a temperature of $1,000^{\circ}\text{C}$, maintaining the heated marble at a temperature of $1,000^{\circ}\text{C}$ for a period of at least half

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an hour, cooling the resulting calcium oxide to normal temperature in a desiccator, mixing the cooled calcium oxide with sufficient water to make a paste, drying the paste at a temperature of 140°C for substantially one hour, selecting from the slaked calcium hydroxide so obtained those particles which lie within the range of particle size from 60 to 80 A.S.T.M. mesh sieve, and forming a filter structure of which at least a part consists essentially of the selected particles.

7. A method according to Claim 6 wherein the selected particles are positioned between conventional filter parts to constitute a section of a filter between separate sections constituted by the said conventional filter parts.

8. A method of manufacturing a filter for tobacco smoke in accordance with Claim 1 substantially as hereinbefore described.

9. A method of filtering tobacco smoke comprising the steps of reacting acid gases present in the tobacco smoke with particles of calcium hydroxide having a particle size from 60 A.S.T.M. mesh sieve to 80 A.S.T.M. mesh sieve thereby forming a layer of water on the particles, and passing further tobacco smoke through the water layer.

DATED this 5th day of September, 1973.

LEEO LIMITED

By Their Patent Attorneys,

ARTHUR S. CAVE & CO.



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